Reflecting on the Role of Sound in an Immersive Multimedia Intervention for Health Communication

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ABSTRACT

We reflect on the role of sound in an immersive multimedia health communication intervention: *Jane's Story*. Health communication aims to inform, educate, and ultimately produce behavioral change (sometimes urgently, sometimes long-term). *Jane's Story* is an immersive eight minutes animation aimed at young people. It is produced as a tool to be used by educators to stimulate discussions around the topic of chronic diseases and disorders (diabetes, obesity, cerebral palsy, etc.) in adolescents. The intervention design merges visual methods typically used in health communication (infographics, data visualisation), with storytelling techniques typically found in filmmaking (first-person voiceover, use of music and sound design). We surveyed 37 subjects on the effectiveness of the intervention and the perceived role of its soundtrack. The analysis of the results reveals that the intervention was perceived as being generally effective, and that voice, music and sound design strongly support the communication of the health message and the emotional engagement of the audience with the topic. We then consider these results through the lens of Construal Level Theory, which describes how psychologically distant and urgent an issue is perceived to be depending on how it is communicated.

We then suggest that sound might be particularly effective in communicating concrete and urgent health messages that require a quick change, while symbolic visuals might be more effective portraying more general health messages, requiring long-term change. Additionally, this intervention shows that these two approaches can be combined effectively. Finally we report limitations and lessons learnt from this particular intervention that should be taken into account when designing multimedia health communication interventions.

1. INTRODUCTION

Health communication can be defined as "the use of communication techniques and technologies to (positively) influence individuals, populations, and organisations for the purpose of promoting conditions conducive to human and environmental health." [1] While the more immediate aims of health communication are to inform and educate, the final, more difficult, goal is to achieve behavioral change in the audience towards a healthier life. Communication methods have radically changed in the last twenty years. The most recent technological developments (sophisticated mobile technology, high definition audio and visual media, high quality sensors and interactivity) have opened up new possibilities. These advances have the potential to revolutionise the way in which health messages are communicated to both the individual and the general public.

The rapid expansion of fields such as eHealth [2] and persuasive technologies [3] confirm the momentousness of such area an of research, which in turn requires that we better understand the communication processes mediated by this technology and media.

Maibach and Holtgrave [1] have identified *entertainment education* (also known as educational entertainment or edutainment) as one of five distinct approaches to public health communication (others being social marketing, risk communication, behavioral decision theory, media advocacy, and interactive decision support systems).

Entertainment education is "the process of purposely designing and implementing a media message both to entertain and to educate, in order to increase audience members' knowledge about an educational issue, create favorable attitudes, and change overt behaviours" [4]. Examples of media used in entertainment education are radio, television, popular music, theatrical performances, interactive computer software systems, and print materials such as comic books and magazines. Entertainment education is thought to have the poten-

tial to attract different audiences with the underlying assumption that people are more receptive to messages conveyed through entertaining experiences and that attention and reception might be higher in such contexts. Importantly, Singhal and Rogers [4] propose that the entertainment element can break down audience resistance to the educational content that, in itself, could be perceived as uninteresting and dull. It is therefore possible that health messages delivered in this way could more easily influence cognitive, affective, and behavioral outcomes. Specifically, positive outcomes could include a greater appreciation of the personal relevance of a problem, an increased knowledge and understanding of the problem, and an increased confidence in tackling the targeted issues. [5] A meta-analysis of published studies on the effects of entertainment education on health communication suggested that overall, entertainment education's effects on health outcomes – as measured by knowledge, attitudes, intention, and behaviors – was small but significant [6].

Examples of entertainment education can be found in family planning, substance abuse prevention, asthma, etc.

2. MULTIMEDIA IN HEALTH COMMUNICATION

A multimedia system delivers a message using a combination of different content forms such as audio, video, text, images, animations, etc. Many health entertainment education applications are multimedia (for example Public Service Announcements or TV programmes with a health message) and sometimes interactive (for example games with a health communication goal).

Two reviews of *Mass Media Interventions* (including television and radio) [7, 8] found that "mass media campaigns may have a positive influence upon the manner in which health services are utilized" despite "limitations relating to methodological quality and completeness of reporting of studies" [7, p.7]", and that "their [mass media] true potential can be better understood, and pursued, by embracing an ecological framework of health that considers determinants of health across multiple fields of influence [8, p. 228]", such as the individual, social network and community levels. Grilli *et al*. [7] also concluded that further work should focus, among other things, on "identifying characteristics of the message which influence the effectiveness of mass media campaigns" [7, p.7].

A review of *Interactive Health Communication Applications (IHCA) for people with chronic disease* [9] concluded that these applications "appeared to have largely positive effects on users, in that users tend to become more knowledgeable, feel better socially supported, and may have improved behavioural and clinical outcomes compared to non-users." [9] The review also concluded that, although what makes such applications effective is still unclear, "it is likely that there are a number of factors contributing to IHCAs' ability to improve knowledge, including the interactive nature of the information, the use of audio, graphics and video to present the information, and users' ability to revisit the information repeatedly over time." [9] Examples of successful interventions can be found in the area of childhood obesity [10], chronic back pain [11], to name but two. Despite the fact that extensive evaluation is lacking, overall these reviews conclude that, existing data on the effectiveness of multimedia (both interactive or not interactive) applications for health communication is promising.

2.1 Persuasivenss

Persuasiveness is a key characteristic of health communication as messages are designed with the deliberate intention to induce a voluntary change in attitudes and behaviours. Persuasion can be produced by the way a message is designed and presented. Research [12, 13] suggests that the presence of a structured narrative, both in interactive and non-interactive applications, can strongly support communication and persuasion. Although there is no general agreement on the definition of narrative, three main components are widely recognised as crucial in most narratives: the presence of a narrator's voice, the existence of a conflict within a given context, and the description of actions taking place over time to resolve that conflict [14, 15]. The articulation of a message through a narrative structure "can captivate the audience, driving anticipation for plot resolution, thus becoming a self-motivating vehicle for information delivery. This quality gives narrative considerable power to explain complex phenomena and causal processes, and to create and reinforce memory traces for better recall and application over time." [12, p. 13627] The medium used to convey the message, and its technology, can also contribute to the persuasiveness of a message. Fogg defines persuasive technology as "any interactive computing system designed to change people's attitudes or behaviors." [3, p. 1]. While Fogg places a lot of value on interactivity as a way to facilitate persuasiveness, we would argue that audiovisual immersion would produce a similar effect as it arguably

facilitates transportation and identification with the characters in the narrative. Overall, what seems to make a message persuasive is the degree of audience engagement created by the content/narrative and the way it is conveyed through the technology used.

3. THE DESIGN OF *JANE'S STORY*

Jane's Story was part of a public engagement project (Chronic health issues of adolescents: is the world listening?) funded by the Centre for Chronic Diseases and Disorders (C2D2, https://www.york.ac.uk/c2d2/) of the University of York and supported by the Wellcome Trust (https://wellcome.ac.uk/). The interdisciplinary team comprised health sciences researchers as well as sound and music theorists and practitioners and filmmakers. The authors produced the animation's soundtrack. The aim of the overall project was to develop an effective immersive multimedia entertainment education intervention that used video, sound (voice, music, sound effects and sonification) and immersion to communicate public health issues to young people, their parents, and educators. The piece focused specifically on communicating the social, mental and physical difficulties experienced by young people living with chronic diseases as well as disseminating global statistics about chronic conditions such as asthma, obesity, diabetes mellitus, and cerebral palsy. The data presented in the intervention were extracted from a World Health Organisation discussion paper *The Adolescent with a Chronic Condition* [16]. Specifically four data tables representing the prevalence of specific chronic diseases in young people in different countries in the world, are portrayed in the piece: Table 2: Prevalence of type 1 diabetes mellitus (p. 27); Table 3: Prevalence of asthma (p. 28); Table 4: Prevalence of cerebral palsy (p. 29); Table 5: Prevalence of overweight/obesity (p. 30). Additionally, excerpts from discussions in public internet fora where young people exchange experiences of living with chronic diseases, were quoted in the animation. The design of the intervention was influenced by two approaches: the use of infographics in health communication [17, 18, 19]; and the use of a fictional story, scripted on the basis of research data from interviews with young people, told from a first person point of view by *Jane*, the fictional narrator. The first-person narrative is a device used extensively in documentaries and television: it facilitates identification and empathy, and therefore engagement. The first person narrative approach was strongly recommended by the professional filmmakers in the project team. The script describes the typical stages a young person goes through when they discover they have a chronic illness (some of the stages are: flare up, diagnosis, denial, anger, acceptance), but it does not identify any specific disease, signaling to the viewer that, although this is a story told in a first-person style, it is still fictional and general. In summary, we wanted to communicate general health information based on research in an engaging way and we did this by using the visual and the aural domains in quite different ways. The visual domain, with the use of infographics, text and diagrams, was used to remind the viewer of the general and objective nature of the information given; while the aural domain was used, to a large extent, to engage the viewer with the issues by facilitating identification and empathy. However some aspects of the soundtrack, the sonification of the data that accompanies the graphs presented towards the end, attempted to use sound in a more objective and general way. The animation (approximately 8 minutes long) was produced for a 3Sixty cube space with 4 four large screens and 32 speakers surrounding the audience.

Figure 1: People experiencing Jane's Story in the 3Sixty immersive space.

The immersive nature of the intervention was also designed to increase the engagement and focus on the health message. A single screen stereo version of the animation can be viewed at the following link:
https://www.york.ac.uk/c2d2/projects/outreach/adolescents/.
This version lacks immersion, but it gives a sense of the visual and aural elements used in the intervention. *Jane's Story* was exhibited a number of times both as an immersive audiovisual piece and in the cinema as a single screen piece. The audience varied between young people, health professionals and academics, teachers, and general public. Overall the reception has always been very positive.
A survey was carried out to attempt to identify how the soundtrack elements (voice, music, and sound design - sound effects and sonification) contribute to the communication of the health message

and the audience emotional engagement. The results are described below.

4. SURVEY

A total of 37 subjects (12 male and 25 female) were surveyed (average age of 30.4, Standard Deviation (SD) 7.4). Thirty subjects declared having direct or indirect (through family or friends) experience of chronic disease and 7 subjects declared not having this experience. The subjects experienced the immersive intervention in groups of 4 or 5, and afterwards they were asked to fill in a questionnaire about the effectiveness of the intervention, and the role of the soundtrack in conveying the health message and emotionally engaging the audience. Subjects were aware that the animation was immersive, on the subject of chronic diseases, and were asked to not speak to each other at any moment during the piece and while answering the questionnaire. Subjects received a £8 voucher for their participation.

The results provide interesting insights for further study in this area.

4.1 The overall animation

89% of the subjects found the film educational[1] and 70% stated that they would recommend the animation to others[2]. On a scale from 1 (not at all) - 5 (extremely effective) the animation effectiveness was rated 3.9 (SD 1.1).

Comments were generally positive and included "Excellent way to educate"; "To a younger audience - excellent; but could also benefit parents to help them understand"; "I think making such an emotive connection and seeing things from the girl's perspective helped to convey the issues surrounding the health problem".

A number of limitations were also highlighted: "I felt that there wasn't really much by way of a conclusion"; "I wanted to know what particular illness I was learning about"; "Perhaps lack of clarity around diagnosis would stop audiences engaging".

The most recurrent feelings in the audience were: "curious - wanted to know what the condition was"; "sympathy"; "sadness"; "confusion"; "I experienced the fear and confusion of the character when she didn't understand her condition"; "A desire to know what the condition was".

The most recurrent aspect that the audience disliked about the intervention included: "I found it hard to know where to look with four "screens""; "It was not clear what the girl's condition was. The message was not particularly clear at the end"; "I feel that I didn't really understand the condition Jane suffered? Was that intentional to make it a more general story - or did I just miss it? It was confusing because I felt I was missing something, in a way to make it harder to understand."

4.2 The role of the soundtrack

We asked the subjects to score on a scale from 1 (none at all) – 5 (a great deal) how much each of the soundtrack components (voice, music, sound design) contributed to the delivery of the film overall message and to its emotional content.

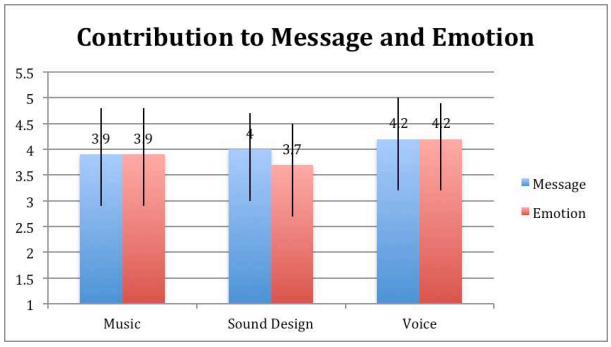

Figure 2: Music, sound design and voice contribution to health message's communication and audience's emotions

The Wilcoxon Signed-Rank Test indicates that, in terms of contributions to the message, the difference between voice and music results is significant ($Z = -1.9777$, $p = 0.0477 < 0.05$). The same test indicates that, in terms of contributions to the emotions, the difference between voice and music results is significant ($Z = -2.1138$, $p = 0.03486 < 0.05$) as well as the difference between voice and sound design results ($Z = -2.9381$, $p = 0.00328 < 0.05$).

The voice seems to contribute to the delivery of the message and the overall emotion the most, confirming the prominence of voice and speech in complex soundtracks. Then music and sound design seem to contribute slightly less, but very similarly, to the delivery of both message and emotion, with the sound design contributing slightly more in delivering the message than the emotions.

These results are confirmed by the most recurrent comments: "The music sets the mood of the video"; "It helped emphasize the mood throughout the story"; "And also to put the story into context, for example school/club".

Most people attributed the most communicative impact to the voice, but attributed the portraying of emotions largely to the music: "The emotion was definitely carried forward by the music when you could feel the disappointment, anger and eventual acceptance and joy". A few people perceived the

[1] 8% didn't find the film educational, and 3% didn't know (one person did not answer).

[2] 22% were undecided, and 8% would not recommend the film (one person did not answer this question).

music as “not particularly emotive”; “un-invasive, but not boring”. They liked the music’s “simplicity” the fact that “it held my attention and felt contemporary”; “I neither liked or disliked the music really. Which is possibly a good thing as I remember the "message" more than the music”. Most people said about the sound design “They helped to visualise the situation when most of the animation was symbols”; “Contributed massively, enables you to lose yourself in the presentation”; “I think at times it may have detracted from the message. The beginning of the piece is deliberately ambiguous, and having such a bombardment of scary, intimidating noise shifts the focus away from listening to the narrator”.

Most people perceived that sound design had an emotive effect, but not as strongly as music or voice. “The ambient sounds helped convey emotion, but the effect of the music was much more significant.”; “I think sound effects reflect some stages in the story rather than influence the emotion of the listener”; “The sound effects carry myself or rather transport myself into her experience with her despair, turmoil and eventually her joy in breaking out from the depressive state that she was in”.

The spatialisation of the sound design and consequent immersive effect was liked by the audience as well as its narrative qualities: “It felt like it truly came from all around, not just several points”; “[I liked] the way the sound moved around you”; “It did have a narrative effect on its own. It could almost replace the voice narrative”; “It gave the presentation more depth”; “The sound design cleverly immersed the listener into the classroom and hospital scenes especially”.

Subjects confirmed the voice as the main carrier of the message and an important carrier of emotions: “The majority of the message was provided by the voice”; “The voice was very believable”; “I would not hear each word spoken by the narrator as the voice was spoken too quickly and softer than the music itself. Maybe because I'm not a native speaker but I was able to discern the message conveyed through the intonation.”; “The voice felt authentic, identifiable as Yorkshire/Northerner, making the presentation feel more intimate.”; “As if they were chatting with you”; “It made the words being said real - a real person”; “It gave the message a more personal feel and made me empathise more with the character”; “the voice was the main emotional feature”; “it makes the story feel real and personal, close to you”; “The voice was fairly similar throughout. Nearer the end the voice seemed to register more emotion as the character came to terms with her illness but the emphasis seemed to be on the sound effects and music for me.”

The audience particularly liked the voice because it felt: “very believable”; “authentic”; “convincing”; for its “"normalness", [the] slight regional accent made me feel confortable and gave me belief in the genuiness of the story”; “it felt genuine, sincere, believable and therefore was emotive”; “made me identify with her”.

4.3 The sonification

Towards the end of the animation, a number of graphs showing the prevalence of chronic illnesses around the world are shown graphically and also sonically through sonification. The graphs showed a globe turning with percentages of prevalence of particular diseases or disorders showing in each country, while the sonification audio output resembled that of a Geiger counter or a Morse signal. 60% of the subjects said they liked the sound; 35% were unsure whether they liked it or not; and 5 % did not like it. However only 32% of the subjects thought that there was a relationship between the data displayed on screen and the sonified data; 49% were not sure; and 19% did not think that there was a relation between sound and data.

These results are encouraging in regard to the type of sound chosen for the sonification, which was interpreted perhaps as reminiscent of data transmission between different places on earth. However, the sonification was not a clear display of the data. While in this intervention the clarity of the sonification as a display of information was not crucial, it is evident that, at least in this specific case, the visual display was more informative than the auditory display.

The comments about the sonification reflect this result: “I didn’t notice any particular sound design”; “I didn’t find the sound design for the last section especially memorable”; “I did not notice a specific relationship, but it worked well”; “I think it is timed in a similar fashion to when particular data points appear on screen”; “[it sounds] like lots of data crunching together. Matrix [the film] influence?”.

Sonification has been shown [24] to be potentially useful in health communication applications, especially in the context of mobile technology where visuals are restricted, however further research is needed to fully understand how to employ it effectively.

4.4 Interesting differences between subject groups

Twenty-four out of the 25 female subjects (96%) found the film educational, while only 8 out of the 12 male subjects (67%) found the film educational. 19 out of 25 female subjects (76%) would recom-

mend the film, while only 6 out 12 (50%) male subjects would recommend it.

The score for overall effectiveness confirms this trend, with female subjects giving an average score of 4 (SD 0.9) and males of 3.5 (SD 1.2).

It is possible that the use of a female character in the film, Jane, facilitates identification and, consequently, engagement with the intervention in female audience members. Identification and therefore gender considerations, could have a considerable effect in health communication. This should be considered in the design of similar interventions.

In relation to this one subject commented: "I wonder how the gender of the voice/the main character influences the message perceived. Maybe it would be better to have a gender neutral voice or name." It is clearly quite impossible to have a "neutral" voice. Even in the rare occasions when voices are quite ambiguous, we tend to assign a gender to them in our minds. When a character is "materialized" through their voice it cannot easily be made general, un-gendered, and this has an effect on the audience identification and engagement.

Thirty of 37 subjects declared that they had experiences, either directly or indirectly, of chronic illness. Twenty-one of these 30 subjects (70%) said that they would recommend the film, while only 3 out of the 7 (43%) of the remaining subjects (with no experience of chronic diseases) would do the same. Additionally, the subjects with experience of chronic illness scored the effectiveness of the intervention 4 (SD 1), while the remaining subjects scored 3.4 (SD 1.2).

This seems to point to the fact that people with experience of a chronic disease, therefore with a personal involvement in the issues portrayed in the film, are more likely to think that it is important for others to watch a film of this kind. It could also suggest that people without experience of chronic illness are more difficult to convince and engage.

With regard to the contribution of the soundtrack elements (music, sound design voice) to the message and emotion, the subjects with no experience of chronic illness seemed to attribute more importance to music (average score 4.4 (SD 0.5)) than voice (average score 4 (SD 0.8)) to the elicitation of emotion. The same group attributed more importance to sound design (4.1 (SD 0.4)) than voice (3.7 (SD 1)) for the communication of the message. The group with experience of chronic illness follows the overall trend and attributes more importance to voice, rather than music and sound design, to the creation of message and emotion. These results could suggest that people without a strong personal involvement in the issues represented pay more attention to relatively abstract elements such as music and sound design than voice. As 6 out of 7 (86%) subjects in this group found the film educational, if this could be found to be true, it could mean that, putting more attention in the creation of sound and music could be used to engage this group of people more, and increase their knowledge of the health issues described which are not familiar to them.

5. SOUND MAKES IT CLOSE AND PERSONAL

In this multimedia health communication intervention we tried to combine two different approaches, which reflected the expertise in the research team, one borrowed directly from health communication, using infographics and graphs to visualise health data, and one from television production, a first person-based storytelling approach which, in this case, is mainly realised through the soundtrack design and has the aim to engage the audience with the health message. The people who experienced the immersive piece seemed to generally like the approach taken and found it quite effective.

An analysis of the survey results with regard to the role of the soundtrack elements in this intervention reveals that sound is indeed, for the majority of the time, very effective in engaging the audience at an individual, personal and emotional level, but perhaps less so at portraying data. Sound is rarely emotion or gender neutral, we cannot easily escape it (we do not have ears lids) and, even when not explicitly spatialised, it is immersive because it "spreads" around the room. These characteristics, which were not fully at the forefront of our minds when designing the intervention, could perhaps be important if we look at them through the lens of Construal Level theory (CLT) [10, 21, 22], a psychological theory that provides a useful framework for designing effective health communication applications. One of the main aim of health communication is to reduce the perceived "distance" between the message and the audience. CLT proposes that the psychological distance to an object or event influences a person's thoughts and behavior in relation to that object or event. Psychological distance is assumed to have a number of interrelated dimensions (time, space, social distance, and hypotheticality) that together affect our mental construals of objects and events. CLT research show that people mentally construe objects that are psychologically near in terms of low-level, detailed, and contextualized features, whereas the same objects or events at a distance are construed in terms of high-level, abstract, de-contextualised

and stable characteristics. This way of thinking about events and objects affects how we make predictions, evaluations and affects our behaviour. Health messages often attempt to affect our behavior on at least two different levels: increase our perception of risk in situations that have negative outcomes (smoking increases the risk of cancer), and persuade us that generally positive and healthy behaviors are good for us (eating more fruit and vegetables is good for you). Chandran and Menon [23] have shown that a message presenting a negative outcome (a risk) as being close is more effective in inducing behavioral change than the same message presented as distant. For example, you need to stop smoking *now*, otherwise your risk of cancer will increase *tomorrow*. On the other hand, "persuasive arguments appealing to idealistic values appear to be more persuasive for temporally distant, as opposed to near, attitude objects." [21 p. 12] For example, increase your intake of fruit and vegetables *in your life*, and you *will live longer*. Additionally, it has been shown that congruency between desired task and relevant message distance cues highly increases the effectiveness of the message [21]. For example, you need to stop smoking *now*, otherwise your risk of cancer will increase *in your life*, is not as effective as you need to stop smoking "*now*, otherwise your risk of cancer will increase *tomorrow*" in changing behavior quickly. Summarising, it seems that urgent behavioral changes are more easily elicited with a message that portrays the issue as psychologically close (temporally, socially, etc.), while long-term changes are more effectively presented with a message portraying issues as psychologically more distant. With this in mind, we suggest that sound, being immersive, often emotive and localised, is best at portraying the risk-related messages that need behavioral changes urgently; while visuals, particularly when they are used in their symbolic form, could be better at portraying messages that aim to induce long-term changes. This intervention uses both these approaches. The sound brings the problem close, it makes it concrete, and perhaps it would make a young person think about their immediate behavior towards a classmate with a chronic disease more than general information (graphs and text) alone; while the visuals provide a wider, more distant and general context that can perhaps influence the individual's longer-term approach to the issues.

6. CONCLUSIONS

We have presented the design of a multimedia immersive health communication intervention and the results of a survey on its effectiveness and the role of the sound in it. Results indicate that sound has strong potential to make information concrete, close, and personal, facilitating identification, empathy and an emotional response. Reconsidering the design approach utilised in light of psychological theory that links the perceived distance of an issue with long-term or short-term behavioral changes, we suggest that sound might be particularly effective in communicating health messages that require urgent changes because it brings the message close and can make it more personal, while visuals, in particular symbolic visuals, might be better at communicating messages that require long-term changes. This intervention also suggests that the two can be combined, and produce an effective outcome. Further research would need to be carried out to fully investigate these suggestions.

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